

# Ground-Based Measurements of Stratospheric Composition from Mt. Barcroft, California

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The MkIV is an FTIR spectrometer designed and built at JPL in the 1980's for remote sensing the composition of the Earth's atmosphere by solar absorption spectrometry. Optically, MkIV is very similar to the JPL ATMOS instrument, which flew three times on the Space Shuttle. Both use double-passed configurations with a KBr beamsplitter and compensator, in order to cover the mid-infrared. The main advantage of the MkIV is that it uses two detectors in parallel, a HgCdTe photoconductor for the long wavelengths and an InSb photodiode for the short wavelengths, allowing the entire 650 to 5650  $\text{cm}^{-1}$  region to be measured simultaneously. At a 10 kHz sampling rate, each 130 cm OPD interferogram takes 3 minutes to acquire.

Although the MkIV instrument was designed primarily for balloon flights, it has also made measurements from the NASA DC-8 aircraft and has performed hundreds of days of ground-based observations. The latter were made in support of the **Network for Detection of Stratospheric Change (NDSC)**, a collaborative, international effort to monitor the changing composition of the **stratosphere** by a variety of measurement techniques, including FTIR spectrometry. Indeed, the MkIV instrument has made ground-based measurements for several years from JPL (Pasadena, California). However, the low altitude (350m) and warmth of this site made it unsuitable for measuring gases whose spectral signatures are blended with lines of  $\text{H}_2\text{O}$  (e.g.  $\text{NO}_2$  at 1600  $\text{cm}^{-1}$ ,  $\text{HNO}_3$  at 896  $\text{cm}^{-1}$ ) or with temperature-dependent lines of  $\text{CO}_2$  (e.g.  $\text{ClNO}_3$  at 780  $\text{cm}^{-1}$ ). Moreover, JPL adjoins a large pollution source (Los Angeles) for many of the gases that we are trying to monitor (e.g.  $\text{O}_3$ ,  $\text{NO}_2$ , hydrocarbons, chloro-fluoro-carbons), which confuses the interpretation of the results.

We therefore decided that the MkIV ground-based observations would be of greater scientific value if they were made from a site that was at a higher altitude and less polluted than JPL. Since the MkIV instrument had been designed from the outset to be flown on balloons, when it is controlled remotely and powered by batteries, this made it feasible to take ground-based observations from a very remote site with little infrastructure.

The site finally chosen was the Barcroft facility of the White Mountain Research Station. At an altitude of 3800 m, this is basically the highest point in the Western USA to which a large vehicle, such as the 36-foot trailer that houses the MkIV instrument and associated equipment, can be hauled. It is also far from possible sources of gas pollution, being more than 350 km from the nearest large city (San Francisco). Although the Barcroft facility does not have ground power in the winter, or phone lines, it is a very sunny site, providing the opportunity for solar power generation, and is well served by cellular phone.

This paper describes how the MkIV instrument was adapted for remote operation from the Barcroft site, where the harsh winter conditions make access difficult. Some of the main technical challenges will be discussed including, (i) operation from solar panels and batteries, (ii) cooling the detectors with  $\text{LN}_2$ , (iii) instrument control and monitoring over a cellular phone, and (iv) data storage, processing and analysis. Finally, MkIV spectra measured from Barcroft are compared with those measured from JPL to highlight the advantages of the higher altitude site.